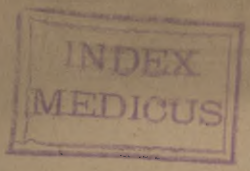


# Teno-Suture and Tendon Elongation and Shortening by Open Incision; Advantages and Disadvantages of the Various Methods.

CLINICAL LECTURE DELIVERED AT THE JEFFERSON MEDICAL COLLEGE HOSPITAL.

BY H. AUGUSTUS WILSON, M.D.,

Clinical Professor of Orthopædic Surgery in the Jefferson Medical College and in the Woman's Medical College; Professor of General and Orthopædic Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine, etc.

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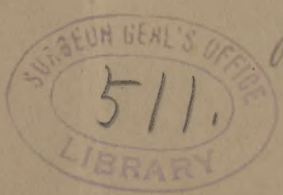

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# TENO-SUTURE AND TENDON ELONGATION AND SHORTENING BY OPEN INCISION; ADVANTAGES AND DISADVANTAGES OF THE VARIOUS METHODS.

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GENTLEMEN,—In a former clinic you saw the subcutaneous methods of dividing tendons demonstrated by suitable cases, and heard the merits of each one discussed and the disadvantages indicated. This morning I shall speak of the different open methods of splicing, shortening, and elongating tendons, and shall endeavor to point out clearly the advantages and disadvantages of each one, and illustrate them.

Subcutaneous tenotomy obviates, in a great measure, the risk of suppuration, but at times the disadvantage of failure of union obtains, whether from simple failure of the tendon ends to unite, or from nutritive or suppurative changes, or from muscular action disturbing the relation of the ends. Again, faulty union may occur from insufficient tendon surfaces being in contact, or from the united portions being too small and thin, thereby causing a weakness of the parts: so that in doing a tenotomy or a teno-suture many points must be carefully considered in order to insure safe and good results. In cases with inactive muscles the results are apt to be much less satisfactory than otherwise, as there is generally interference with nutrition.

Cases which have previously had cellulitis or traumatism about the tendon frequently prove very unsatisfactory because of the cicatricial tissue in the part and the danger of again exciting the inflammatory processes.

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[1] Reported by J. Torrance Rugh, M.D., chief clinical assistant of the Orthopædic Department.

Simple division of the tendon does not always allow sufficient correction of the deformity; for example, after an abscess in the foot, contractures, due to the adhesions about the tendinous parts and the extensive infiltration of the connective-tissue structures, prevent correction, even though tenotomy has been carefully and thoroughly done. In such cases the open method is much the safer and surer, as all other contracted tissues can thus be readily reached.

One of the first methods of elongating other than by simple division was suggested about six years ago by Dr. J. Neely Rhoads, of Philadelphia. It is done subcutaneously, and a knife (Fig. 1) for the pur-

FIG. 1.

Allis' knife for Rhoads' operation.

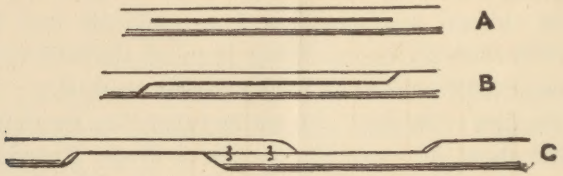
pose was devised by Dr. O. H. Allis, of Philadelphia. This knife has a long shank and a short blade with a curved cutting edge. The method of procedure is as follows. After puncturing the skin above the upper point of division, introduce the knife-blade flatly between the skin and the tendon, turn it, and cut through the middle of the tendon, longitudinally, for the required distance, then cut out at one side and withdraw the knife. Introduce it at the lower end of the longitudinal incision and cut off the opposite half of the tendon. Elongation can thus be accomplished and the ends be allowed to overlap for tendinous union. No sutures are employed, as the entire procedure is subcutaneous. Dr. Rhoads also suggested the use of this method in lengthening nerves and bones. Where but a small amount of lengthening is desired, he suggested (*Medical News*, November 28, 1891) cutting half through the tendon at different levels and from opposite sides, leaving some longitudinal fibres to slip on each other, thus gaining slight elongation.

Where lengthening of the tendon is desired, and splicing and tenotomy are inadvisable, Dr. F. Lange, of New York, suggests (*Medical News*, January 9, 1892) cutting the tendinous portion in the fleshy part of the muscle. The muscular fibres are easily stretched the desired length, and there is no risk of non-union of the tendon.

Mr. Anderson, of London, on October 18, 1889, devised and practised a method (*London Lancet*, July 2, 1891) of tendon elongation, which, though the tendon is incised similarly, differs from and excels Dr. Rhoads' method in being done openly and with sutures through

the severed ends. It also obtains a positive and definite increase in length, and perfect apposition of the severed ends. (Fig. 2, *A*, *B*, *C*.)

FIG. 2.




*A*, tendon split longitudinally; *B*, section completed by incisions at extremities of the fissure; *C*, divided tendon elongated and sutured. (Anderson's method.)

Dr. W. W. Keen, of Philadelphia, performed, independently, the same operation on November 29, 1890 (thirteen months after Mr. Anderson), and published it (four and a half months before Mr. An-

FIG. 3. FIG. 4. FIG. 5.

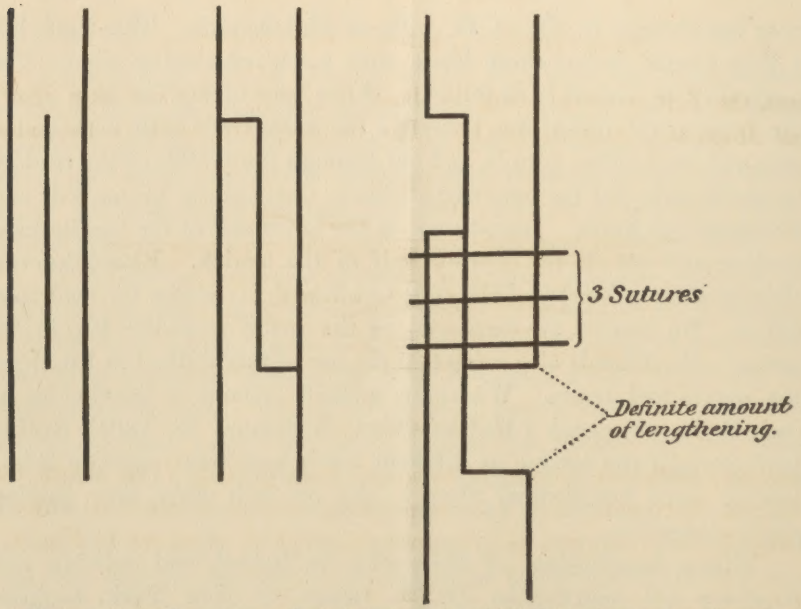



Diagram illustrating a new method of tenotomy, by which the tendons are lengthened to a definite extent, instead of the present hap-hazard method. (W. W. Keen, "Transactions of the College of Physicians," 1891, page 67.)

Fig. 3 shows the first or longitudinal section.

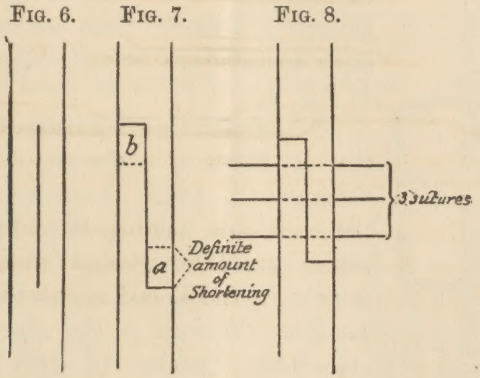
Fig. 4 shows the two transverse sections, each going through one-half of the tendon.

Fig. 5 illustrates the position of the sutures and the definite amount of lengthening.

derson's paper appeared) as an original method of obtaining positive and definite lengthening of a tendon; but upon learning of Mr. Anderson's priority in performing it, he resigned all claims of originality

in favor of the former. (Figs. 3, 4, and 5 are diagrams from Dr. Keen's article showing his results, and are exactly like Fig. 2, *A*, *B*, *C*.)

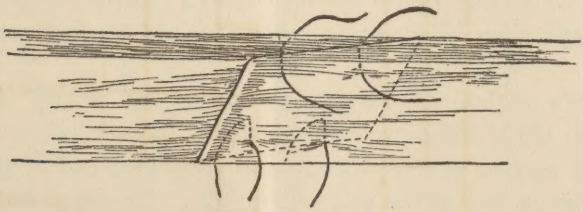
After the publication of this method of elongation, I suggested its use in shortening a tendon, and I have performed it with marked suc-




Wilson's adaptation of Anderson's method to shortening.

cess, the first occasion being on June 10, 1891. (*International Medical Magazine*, August, 1893.) The incisions are made in the same

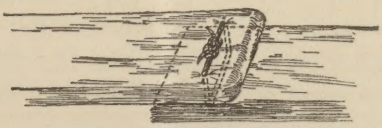
Fig. 9.



Willetts' operation.

manner, sufficient tendon is removed from *a* (Fig. 7) to obtain the desired shortening, then a corresponding amount is removed from *b* (Fig. 7) for symmetry, and the ends are stitched, as shown in Fig. 8.

Fig. 10.

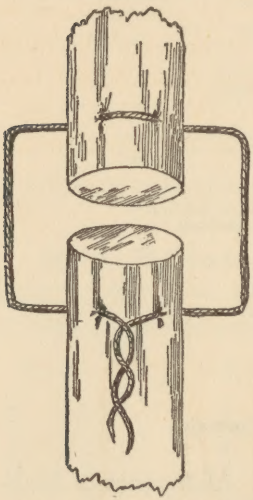


Esmarch's method. (After Roberts.)

Another method which has been adapted to lengthening or shortening is that of Mr. Willetts, of London. (*British Medical Journal*, May

31 and June 14, 1884.) After the tendon has been exposed, it is cut diagonally from without inward and from below upward, the ends are allowed to slip past each other for the required distance, and are there held by two sutures on each side; if for shortening, the necessary amount is removed from one end and the oblique surfaces are brought together, as shown in Fig. 9.

FIG. 11.



Le Fort's method. (After Lejars.)

Of the methods of suturing divided tendons, that of Esmarch is the simplest. (Roberts' "Surgery," p. 140.) It consists in overlapping the ends and holding them by means of a suture passed through and through. (Fig. 10.) Another is end-to-end anastomosis, as done by Le Fort (*Journal of the American Medical Association*, October 14, 1893), in which a suture is passed into the side of one end, out in front, into the front again, and out at the other side; then each end of the suture is passed into the corresponding side of the opposite end and out in front and there tied. (Fig. 11.) This secures the tendon ends in the desired position, and prevents separation by muscular contraction, which frequently follows tenotomy.

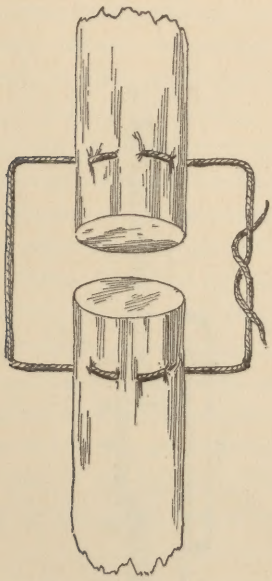
Wölfler's method (*Journal of the American Medical Association*, October 14, 1893) differs from the above in the suture's being passed in and out several times, partially encircling each end of the tendon, and in its being tied at the side. (Fig. 12.) The same end is accomplished as above, but the method illustrates, as do others I shall presently show you, the ingenuity of surgeons in attempting to obtain the same results.

Another method is that of Le Dentu. (*Journal of the American Medical Association*, October 14, 1893.) One suture, passed through each end, is tied at the side, and two supplementary sutures, one on each side of the tendon, are introduced nearer the ends, and at right angles to the first suture, as is shown in Fig. 13. These three methods, all very much alike, were originated about the same time by three different men, each ignorant of the other's plans.

About a year and a half after these were published, Dr. Trnka published a method which had been devised by him in 1887. (*Centralblatt für Chirurgie*, No. 12, p. 258, March 25, 1893.) It differs

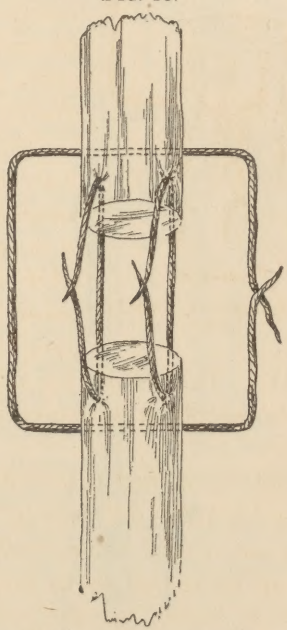
from those mentioned in the manner of inserting the suture. It is passed transversely through the anterior half of one end of the tendon and back through the posterior half, then in the same manner through the other end, loops being left on that side on which the suture is passed directly back through the tendon. (Fig. 14; an end view is shown in Fig. 15.) The free ends of the suture are tied, and the loops are connected by a separate suture (Fig. 16), and when drawn taut equal tension is made on each side of the tendon. (Fig. 17.) A simpler method of joining the loops does away with the extra suture.

FIG. 12.



Wölfler's method. (After Lejars.)

FIG. 13.



Le Dentu's method. (After Lejars.)

After the suture is passed through the one end, a long loop being left, it is passed through one side of the other end, through the first loop, and then back through the other side and tied. (Fig. 18.) This method secures firm apposition of the ends and aids very much in obtaining strong union. A method of lengthening has also been devised by him in which the upper end of the tendon is split from within three-eighths of an inch of the end upward the required distance, then cut out to one side, and this half turned downward to be joined to the lower end. In the same manner as the suture was introduced in the other, a suture is passed through the end which was split, the half turned downward

being included in the loop, then through the other end, including the connecting half, and then tied. (Fig. 19.) The half which was split out and turned over acts as the extra suture used in Fig. 17 or the joined loops in Fig. 18.

Fig. 14.

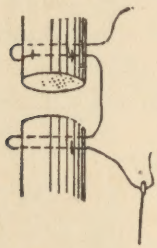


Fig. 15.

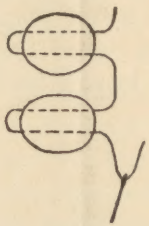


Fig. 16.

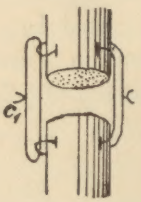



Fig. 17.

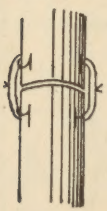


Fig. 18.

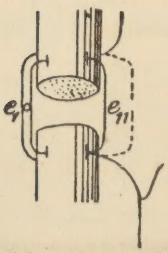
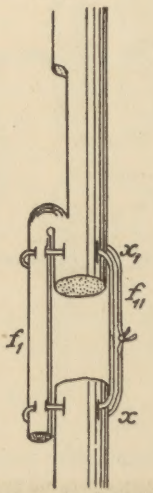



Fig. 19.




Reproduced from the *Centralblatt für Chirurgie*, No. 12, page 258, March 25, 1893.

Figs. 14 and 15 show the method of inserting the catgut suture so as to form the loop into which is to be engaged the connecting material.

Dr. Trnka emphasizes the importance of the loop c, as shown in Fig. 16. A simplification, for the sake of quick adjustment, is shown in Fig. 18. Instead of forming the loop c, in Fig. 16, any proper material may be inserted, such as catgut or a piece of the tendon itself, turned down as shown in Fig. 19.

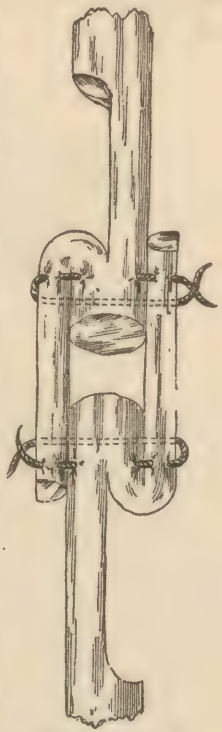
When the catgut used is thin, it can be tied as in Fig. 16; but when it is heavy, it should be sewed fast to both ends of the divided tendon, in the same manner as shown in Fig. 19.

It is strongly urged that sutures through the tendon should not be drawn so tight as to cause the nutrition of the tissues to suffer.

Some time ago I devised (and performed for the first time in September, 1893) a method which has the advantage over Trnka's of there being more tendinous tissue between the two severed ends and

consequently a stronger tendon after union. It is done by splitting both parts of the tendon equally for the required distance from within three-eighths of an inch of the end and cutting out to one side at the other end of the incision and at opposite sides of the tendon. Now turn over these cut halves and pass a suture through each one in the manner shown in Fig. 19, and tie each separately. The result is shown in Fig. 20.

Fig. 20.

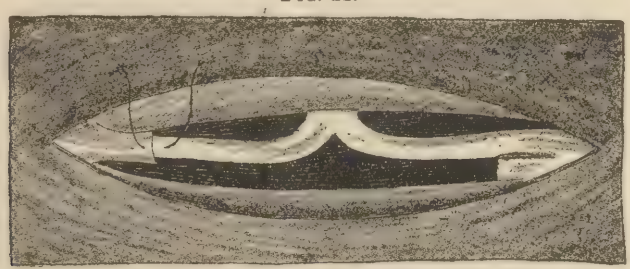


Wilson's method.

Czerny (*Journal of the American Medical Association*, October 14, 1893) provided for strength by utilizing part of the tendon for the lengthening process, transplanting the end of the part cut from the side of one tendon end into the other free end, so that tendinous structure is secured through the entire course. (Fig. 21.) This method can be illustrated by placing one finger of one hand between two fingers of the other, the exact relation of the two tendon ends. They are held in place by through-and-through suturing.

Schwartz (*Journal of the American Medical Association*, October 14, 1893) devised a method of anastomosis where junction of the two ends, for some reason, cannot be effected. He divides a neighboring tendon longitudinally, as in the extensors of the fingers, and cuts off one-half at the distal end of the incision, then attaches the distal end of the severed tendon to this freed end of the half of the neighboring tendon (Fig.

Fig. 21.

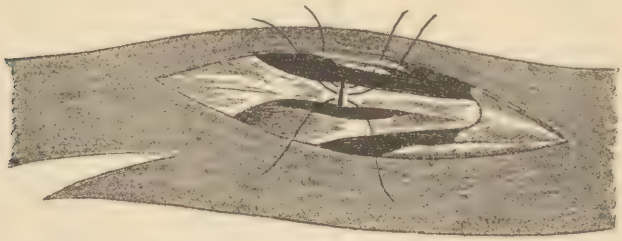


Czerny's method. (After Lejars.)

22), thus securing the movement of the two parts or members by means of the one muscular action.

The Tillaux and Duplay method (*Journal of the American Medical Association*, October 14, 1893) is a very ingenious one, accomplishing the same purpose as that of Schwartz. A longitudinal incision is made

FIG. 22.

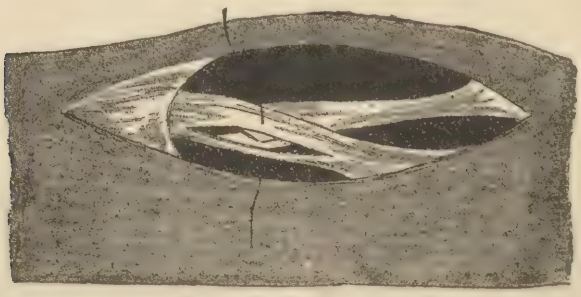


Schwartz's anastomosis. (After Lejars.)

through a contiguous tendon, and the distal end of the severed tendon inserted in it and sutured in position. Two members may thus be operated by one muscle, or two muscles, if the proximal end be inserted, may operate one member. (Fig. 23.)

These operations represent the principal ones for tendon splicing, lengthening, or shortening by division of the tendon in its entirety. Several complicated methods have been devised for the purpose of utilizing tendinous tissue in lengthening and yet not entirely dividing

FIG. 23.

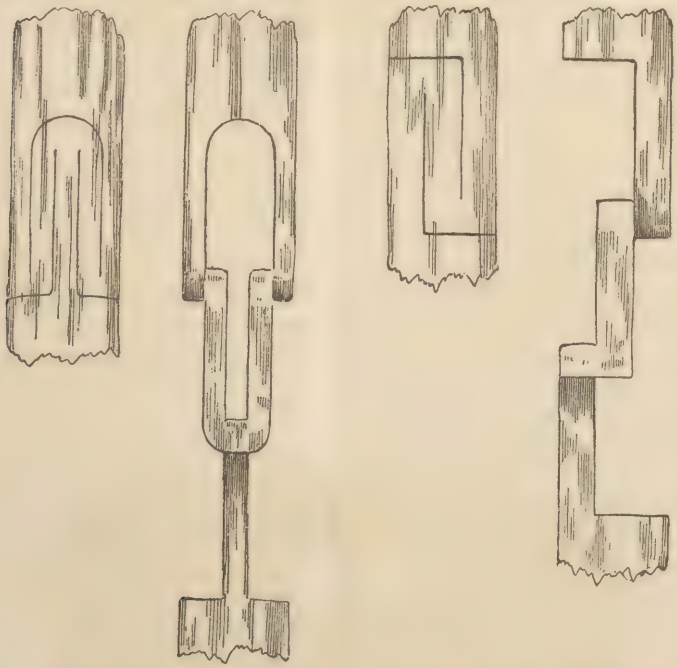


Tillaux and Duplay method. (After Lejars.)

the tendon at any point. The originator of either plan is unknown to me. The first one is the more complicated of the two which I shall mention, and is done as follows. Divide the breadth of the tendon into fifths. From each side and at the same level cut transversely through two-fifths to the middle fifth, then longitudinally for the required distance. Then enter the knife at a point one-half inch below

the transverse cut on one side, and in the line separating the first and second fifths cut longitudinally a distance equal to the first longitudinal incisions, turn the knife and sever the middle three-fifths, turn it again and cut upward for the same distance as the parallel incisions. The last incision will embrace the first two between the longitudinal cuts, and the diagram of the incisions is seen in Fig. 24 *A*. When the tendon is drawn out to its limit of lengthening, it presents the appearance of Fig. 24 *B*. The amount of elongation is graduated by the length of the longitudinal incisions. The disadvantages of the

FIG. 24 *A*. FIG. 24 *B*. FIG. 25 *A*. FIG. 25 *B*.



method are that the tendon must be a very broad one, and that a great degree of skill on the part of the operator is required to perform it, even in a large structure.

The other method which I shall show you is adapted to the same purpose, but is less complicated than the one just explained. The breadth of the tendon is divided into thirds, and longitudinal incisions of equal lengths, but at different levels, the right being the higher, are made between them. Then cut transversely through the left two-thirds to the upper end of the right longitudinal incision, and through the right two-thirds to the lower end of the left longitudinal incision,

as shown in Fig. 25 *A*. Draw on the tendon; it is elongated, is composed of tendinous structure through the entire length, and presents the shape seen in Fig. 25 *B*. In both these methods re-enforcement by sutures of that part of the tendon where the ends remain intact would be necessary. Both show considerable ingenuity on the part of the originator, yet lack that simplicity which is necessary for practical application.

There is a case this morning for the operation of lengthening the tendo Achillis, and, if suitable for the operation, I shall do Rhoads' subcutaneous elongation without sutures. The last operation of lengthening done before you was by the Anderson method. It was the fifty-fourth operation done by me by the open incision and suturing, and is the first one in which I have had suppuration. The cause of the suppuration I do not know. However, the wound is open and has been thoroughly cleansed of suppurative material, and is now doing very well. In this patient observe that about three-fourths of an inch of elongation must be obtained in order to secure correction of the existing equinus, yet there is sufficient length of tendon to allow of the operation and still leave tendinous surfaces in contact.

The long knife is introduced under the skin about two and a half inches above the heel. The tissues are found very firmly bound to the tendon, and quite extensive adhesions are present, showing that a cellulitis had formerly existed in the part. A point of abrasion exists about one and a half inches above the os calcis, which looks as though it had been a point of suppuration, and, if so, might account for the present condition of the structures. These circumstances make the expediency of Rhoads' operation very doubtful, and if, upon another trial, the knife cannot be easily introduced, I shall abandon it. The tissues are as firm in one part as in another, and the inflammatory action has been so wide-spread that I shall do simply a transverse tenotomy, largely because the parts have not been prepared aseptically, as required for all open wounds. After cutting the tendon, there is but a slight gap between the ends upon extension, because of the adhesive bands about the sheath. Having divided them, I shall apply carefully controlled force to separate the adhesion and secure correction. The amount of controlled force which can be applied to a part for correction depends upon the control. Considerable harm may be done by the application of unregulated power, but with judiciously employed force very great good can be accomplished. I can feel the adhesive bands give way each time I apply force, and you can see the foot yielding. Notice how easily it is now straightened, and that not en-

tirely by dividing the tendo Achillis, but partially by tearing loose the contracted peritendinous tissue. There is about three-fourths of an inch separation of the tendon ends now, the deformity is corrected, and the foot can be easily maintained in the corrected position. This case illustrates the fact that deformities do not always yield to simple tenotomy, but that other structures must sometimes be loosened.

It is not at all probable that full restoration of the function of the leg muscles in this boy can be accomplished, and therefore the aim will be to secure a good position, so that a suitable apparatus may be worn later. The foot will be placed at right angles to the leg, and plaster of Paris applied as a temporary retainer.

[NOTE.—One month later the patient walked firmly upon the foot with the assistance of a steel supporting apparatus. There had been an uninterrupted recovery, with firm union of the divided tendon.]